

CLAIMS

1. A multi-layered blown film forming apparatus comprising:

an adapter provided to supply a multiple  
5 types of molten resins;

a forming die provided on a downstream side  
in an axial direction of said adapter; and

a temperature controller mechanism,  
wherein said molten resins of the multiple  
10 types are individually fed to said forming die through  
said adapter,

said forming die comprises:

a main body;

a multi-layer structure of a plurality of  
15 single-layer thin film dies disposed in an inner  
portion of said main body in said axial direction to  
produce a plurality of thin resin films corresponding  
to said molten resins of the multiple types; and

a first annular path formed between said main  
20 body and said multi-layer structure,

a multi-layered thin film in which said  
plurality of thin resin films are laminated passes  
through said first annular path and is outputted as a  
multi-layered thin annular film, and

25 said temperature controller mechanism  
individually controls temperatures of said plurality  
of single-layer thin film forming dies.

2. The multi-layered blown film forming apparatus according to claim 1, wherein said temperature controller mechanism comprise:

a plurality of cartridge heaters provided to  
5 pierce said multi-layer structure;

at least one temperature sensor provided in each of said plurality of single layer thin film forming dies of said multi-layer structure; and

a controller circuit configured to  
10 individually drive said plurality of cartridge heaters based on temperatures set for said plurality of single layer thin film forming dies and temperatures detected by said temperature sensors such that one of said plurality of single layer thin film forming dies is  
15 individually heated by a corresponding one of said plurality of cartridge heaters.

3. The multi-layered blown film forming apparatus according to claim 2, wherein said  
20 temperature controller mechanism further comprises:

a cooling air feeding tube provided to pierce said multi-layer structure, and to discharges cooling air for cooling said plurality of single layer thin film forming dies, and

25 said controller circuit controls an amount of said cooling air fed to said cooling air feeding tube.

4. The multi-layered blown film forming apparatus according to claim 2, wherein each of said plurality of single layer thin film forming dies comprises an upstream-side single layer forming die  
5 and a downstream-side single layer forming die,

an annular cooling air path is formed between said upstream-side single layer forming die and said downstream-side single layer forming die, and

said cooling air from said cooling air  
10 feeding tube flows through said annular cooling air path, to cool said upstream-side single layer forming die and said downstream-side single layer forming die.

5. The multi-layered blown film forming apparatus according to any of claims 1 to 4, further comprising:

a lip main body provided in a bottom portion of said forming die to have a lip portion which has a second annular path connected to said first annular  
20 path such that said multi-layered thin film is outputted,

said temperature controller mechanism further comprises:

an air reserving section provided between  
25 said lip main body and said multi-layer structure;

a bubble air feeding tube provided to pass through said multi-layer structure to said air

reserving section and to feed bubble air to said air reserving section; and

an air nozzle configured to pass through said lip portion to said air reserving section and to  
5 discharges said bubble air present in said air reserving section to an inner portion of said multi-layered thin film outputted from said second annular path, and

said controller circuit controls an amount of  
10 said bubble air fed to said air reserving section through said bubble air feeding tube.

6. The multi-layered blown film forming apparatus according to claim 5, wherein said  
15 temperature control mechanism further comprises:

a band heater provided on an outer circumferential surface of at least one of said lip main body and said forming die, and

said control circuit drives said band heater  
20 to heat said bubble air in said air reserving section.

7. The multi-layered blown film forming apparatus according to any of claims 1 to 6, further comprising:

25 a cooling mechanism provided on a downstream side of said forming die to cool said multi-layered thin annular film.

8. The multi-layered blown film forming apparatus according to claim 7, wherein said cooling mechanism comprises:

a first cooling mechanism configured to air-  
5 cool said multi-layered thin annular film by using cooling airflow;

a second cooling mechanism provided on a downstream side of said first cooling mechanism and configured to cool said multi-layered thin annular  
10 film by using an annular cooling water flow; and

a third cooling mechanism provided on a downstream of said second cooling mechanism and configured to cool said multi-layered thin annular film by using cooling water spray.

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9. The multi-layered blown film forming apparatus according to claim 8, wherein said cooling mechanism further comprises:

a first radiation thermometer configured to  
20 measure a temperature of said multi-layered thin annular film outputted from said forming die in non-contact, and

said first cooling mechanism controls a flow rate of said cooling airflow based on the measured  
25 temperature by said first radiation thermometer.

10. The multi-layered blown film forming

apparatus according to claim 8 or 9, wherein said first cooling mechanism comprises:

an air feeding duct for feeding said cooling airflow to an annular air blow outlet to air-cool said multi-layered thin annular film by using said cooling airflow outputted from said annular air blow outlet;

an airflow rate adjusting unit interposed in said air feeding duct to adjust said cooling airflow rate; and

an air cooling heat exchanger unit interposed in said air feeding tube to cool said cooling airflow.

11. The multi-layered blown film forming apparatus according to any of claims 8 to 10, wherein said cooling mechanism further comprises:

a second radiation thermometer configured to measure a temperature of said multi-layered thin annular film outputted from said first cooling mechanism in non-contact, and

said second cooling mechanism controls a flow rate of said annular cooling water flow based on the measured temperature by said second radiation thermometer.

12. The multi-layered blown film forming apparatus according to any of claims 8 to 11, wherein said second cooling mechanism comprises:

a first cooling water feeding tube configured  
to feed first cooling water;

a first water flow rate adjusting unit  
interposed in said first cooling water feeding tube to  
5 adjust an flow rate of the first cooling water;

a first cooling water heat exchanger unit  
interposed in said first cooling water feeding tube to  
cool said first cooling water; and

a water reservoir unit configured to store  
10 said first cooling water, and

said water reservoir unit comprises a weir  
provided to an inner-side upper periphery of said  
water reservoir unit such that said first cooling  
water overflows as said annular cooling water flow, a  
15 height of said weir being adjustable from a water  
level of said first cooling water.

13. The multi-layered blown film forming  
apparatus according to any of claims 8 to 12, wherein  
20 said cooling mechanism further comprises:

a dewatering unit configured to remove water  
attached to said multi-layered thin annular film  
outputted from said second cooling mechanism, and

a distance between said second cooling  
25 mechanism and said dewatering unit is adjustable.

14. The multi-layered blown film forming

apparatus according to any of claims 8 to 13, wherein said third cooling mechanism comprises:

a plurality of sprays provided to a circumference of said multi-layered thin annular film  
5 to spray second cooling water;

a second cooling water feeding tube configured to feed said second cooling water to said plurality of sprays;

a second cooling water flow amount adjustment  
10 unit interposed in said second cooling water feeding tube to adjust a flow rate of said second cooling water; and

a second cooling water heat exchanger unit interposed in said second cooling water feeding tube  
15 to cool said second cooling water.

15. The multi-layered blown film forming apparatus according to claim 1, wherein said plurality of single layer thin film forming dies have a same  
20 size,

each of said plurality of single layer thin film forming dies comprise:

a truncated conical upstream-side single layer forming die having a truncated conical portion;  
25 and

a truncated conical downstream-side single layer forming die connected to said upstream-side



single layer forming die on a downstream side,

each of said upstream-side single layer forming die and said downstream-side single layer forming die each has a recess portion in a bottom

5 portion, and said downstream-side single layer forming die engages said recess portion of said upstream-side single layer forming die,

said upstream-side single layer forming die receives a corresponding one of said molten resins of  
10 the multiple types, and feeds said corresponding molten resin to said downstream-side single layer forming die, and

said downstream-side single layer forming die comprises a radial resin path and a spiral resin path  
15 formed to a side face of said truncated conical portion and connected to said radial resin path, and outputs said corresponding molten resin fed from said upstream-side single layer forming die to said first annular path through said radial resin path and said  
20 spiral resin path.

16. A multi-layered blown film forming method comprising:

independently controlling temperatures of a  
25 plurality of single layer thin film forming dies, wherein a forming die comprises a main body, a multi-layer structure of said plurality of single layer thin

film dies disposed in an inner portion of said main body in an axial direction;

individually feeding molten resins of multiple types to said plurality of single layer thin film forming dies through an adapter;

producing a plurality of thin resin films corresponding to said molten resins of the multiple types by said plurality of single layer thin film forming dies; and

outputting, as a multi-layered thin annular film, a multi-layered thin film of said plurality of thin resin films from said plurality of single layer thin film forming dies are overlaid, through a first annular path formed between said main body and said multi-layer structure.

17. The multi-layered blown film forming method according to claim 16, wherein said controlling comprises:

comparing a temperature set for each of said plurality of single layer thin film forming dies and a temperature detected by at least one temperature sensor provided in said single layer thin film forming die; and

driving said plurality of cartridge heaters independently based on a result of the comparison such that said single layer thin film forming die is

individually heated by a corresponding one of a plurality of cartridge heaters provided to pierce said multi-layer structure.

5 18. The multi-layered blown film forming method according to claim 16, wherein said controlling comprises:

controlling a flow rate of cooling air fed to a cooling air feeding tube which is provided to pierce  
10 said multi-layer structure such that cooling air is discharged for cooling said plurality of single layer thin film forming dies.

19. The multi-layered blown film forming method  
15 according to claim 16, wherein each of said plurality of single layer thin film forming dies comprise an upstream-side single layer forming die and a downstream-side single layer forming die,

an annular cooling air path is formed between  
20 said upstream-side single layer forming die and said downstream-side single layer forming die,

said controlling further comprise:

cooling said upstream-side single layer forming die and said downstream-side single layer  
25 forming die with cooling air fed from said cooling air feeding tube and flowing through said annular cooling air path.

20. The multi-layered blown film forming method according to any of claims 16 to 19, wherein a lip main body is provided in a bottom portion of said forming die, and has a lip portion having a second annular path connected to said first annular path such that said multi-layered thin film is outputted,

said controlling comprises:

feeding bubble air to an air reserving section through a bubble air feeding tube provided to pierce said multi-layer structure, to said air reserving section provided between said lip main body and said multi-layer structure;

controlling a flow rate of said bubble air fed to said air reserving section through said bubble air feeding tube; and

discharging said bubble air present in said air reserving section to an inner portion of said multi-layered thin film outputted from said second annular path through an air nozzle which pierces said lip portion to said air reserving section.

21. The multi-layered blown film forming method according to any of claims 16 to 20, further comprising:

cooling said multi-layered thin annual film on a downstream side of said forming die.

22. The multi-layered blown film forming method according to claim 21, wherein said cooling step comprises:

5 carrying out first cooling to air-cool said multi-layered thin annular film by using annular cooling air in a first cooling mechanism;

carrying out second cooling to cool said multi-layered thin annular film by using an annular cooling water flow in a second cooling mechanism on a downstream side of said first cooling mechanism;

10 carrying out third cooling to cool said multi-layered thin annular film by using cooling water spray in a third cooling mechanism on a downstream side of said second cooling mechanism.

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23. The multi-layered blown film forming method according to claim 22, wherein said carrying out first cooling comprises:

20 measuring a temperature of said multi-layered thin annular film; and

controlling a flow rate of said annual cooling airflow based on the measured temperature of said multi-layered thin annular film in a first cooling mechanism.

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24. The multi-layered blown film forming method according to claim 23, wherein said carrying out

second cooling comprises:

controlling a flow rate of said annular cooling water flow based on the measured temperature of said multi-layered thin annular film.

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25. The multi-layered blown film forming method according to any of claim 22 to 24, wherein said carrying out first cooling comprises:

feeding a cooling airflow to said annular air  
10 blow outlet to air-cool said multi-layered thin annular film by using said annual cooling air fed from said annular air blow outlet;

adjusting an flow rate of said cooling airflow in a midway of said air feeding tube; and

15 cooling said cooling airflow in a midway of said air feeding tube.

26. The multi-layered blown film forming method according to any of claim 22 to 25, wherein said

20 carrying out second cooling comprises:

feeding first cooling water through a first cooling water feeding tube;

adjusting a flow rate of said first cooling water in a midway of said first cooling water feeding  
25 tube;

cooling the first cooling water in a midway of said first cooling water feeding tube;

storing said first cooling water in a  
reservoir unit; and

cooling said multi-layered thin annular film  
by using said annular cooling water flow overflowing  
5 over a weir from said reservoir unit.

27. The multi-layered blown film forming method  
according to any of claim 22 to 26, wherein said  
cooling mechanism further comprises:

10 a dewatering unit configured to remove water  
attached to said multi-layered thin annular film  
outputted from a second cooling mechanism, and

said carrying out second cooling comprises:  
adjusting a distance between said second  
15 cooling mechanism and said dewatering unit based on a  
desired property of said multi-layered thin annular  
film.

28. The multi-layered blown film forming method  
20 according to any of claims 22 to 27, wherein said  
carrying out third cooling comprises:

cooling said multi-layered thin annular film  
by spraying second cooling water to a circumference of  
said multi-layered thin annular film from a plurality  
25 of sprays;

feeding said second cooling water to said  
plurality of sprays through a second cooling water

feeding tube;

adjusting a flow rate of said second cooling water in a midway of said second cooling water feeding tube; and

5 cooling said second cooling water in a midway of said second cooling water feeding tube.